CLAIMS

What is claimed is:

1. A method of denoising signal mixtures so as to extract a signal of interest, the method comprising:

receiving a pair of signal mixtures;

constructing a time-frequency representation of each mixture;

constructing a pair of histograms, one for signal-of-interest segments, the other for non-signal-of-interest segments;

combining said histograms to create a weighting matrix;

rescaling each time-frequency component of each mixture using said weighting matrix; and

resynthesizing the denoised signal from the reweighted time-frequency representations.

2. The method of claim 1 wherein said receiving of mixing signals utilizes signal-of-interest activation.

3. The method of claim 2 wherein said signal-of-interest activation detection is voice activation detection.

4. The method of claim 1 wherein said histograms are a function of amplitude versus a function of relative time delay.

5. The method of claim 1 wherein said combining of histograms to create a weighting matrix comprises:

subtracting said non-signal-of-interest segment histograms from said signal-of-interest segment histogram so as to create a difference histogram; and

rescaling said difference histogram to create a weighting matrix.

6. The method of claim 5 wherein said rescaling of said weighting matrix comprises rescaling said difference histogram with a rescaling function f(x) that maps x to [0,1].

7. The method of claim 6 wherein said rescaling function

$$f(x) = \begin{Bmatrix} tanh(x), & x > 0 \\ 0, & x \leq 0 \end{Bmatrix}.$$

8. The method of claim 6 wherein said rescaling function f(x) maps a largest *p* percent of histogram values to unity and the remaining values to zero.

9. The method of claim 5 wherein said histograms and weighting matrix are a function of amplitude versus a function of relative time delay.

10. The method of claim 1 wherein said constructing of a time-frequency representation of each mixture is given by the equation:

$$\begin{bmatrix} X_1(\omega,\tau) \\ X_2(\omega,\tau) \end{bmatrix} = \begin{bmatrix} 1 & \cdots & 1 \\ a_1 e^{-i\omega\delta_1} & \cdots & a_N e^{-i\omega\delta_N} \end{bmatrix} \begin{bmatrix} S_1(\omega,\tau) \\ \vdots \\ S_N(\omega,\tau) \end{bmatrix} + \begin{bmatrix} N_1(\omega,\tau) \\ N_2(\omega,\tau) \end{bmatrix}$$

where $X(\omega, \tau)$ is the time-frequency representation of $x(t)$ constructed using Equation 4, ω is the frequency variable (in both the frequency and time-frequency domains), τ is the time variable in the time-frequency domain that specifies the alignment of the window, a_i is the relative mixing parameter associated with the i^{th} source, N is the total number of sources, $S(\omega, \tau)$ is the time-frequency representation of $s(t)$, $N_1(\omega, \tau)$ or $N_2(\omega, \tau)$ are the noise signals $n_1(t)$ and $n_2(t)$ in the time-frequency domain.

11. The method of claim 10 wherein said histograms are constructed according to an equation selected from the group:

$$H_v(m,n) = \sum_{\omega,\tau} \left|X_1^W(\omega,\tau)\right| + \left|X_2^W(\omega,\tau)\right|, \text{ and}$$

$$H_v(m,n) = \sum_{\omega,\tau} \left|X_1^W(\omega,\tau)\right| \bullet \left|X_2^W(\omega,\tau)\right|,$$

where $m = \hat{A}(\omega,\tau)$, $n = \hat{\Delta}(\omega,\tau)$; and

wherein

$$\hat{A}(\omega,\tau) = \left[a_{num}\left(\hat{a}(\omega,\tau) - a_{\min}\right) / \left(a_{\max} - a_{\min}\right)\right], \text{ and}$$

$$\hat{\Delta}(\omega,\tau) = \left[\delta_{num}\left(\hat{\delta}(\omega,\tau) - \delta_{\min}\right) / \left(\delta_{\max} - \delta_{\min}\right)\right]$$

where a_{min}, a_{max}, δ_{min}, δ_{max} are the maximum and minimum allowable amplitude and delay parameters, a_{num}, δ_{num} are the number of histogram bins to use along each axis, and $[f(x)]$ is a notation for the largest integer smaller than $f(x)$.

12. The method of claim 1 further comprising a preprocessing procedure comprising: realigning said mixtures so as to reduce relative delays for the signal of interest; and

rescaling said realigned mixtures to equal power.

13. The method of claim 1 further comprising a postprocessing procedure comprising a blind source separation procedure.

14. The method of claim 1 wherein said histograms are constructed in a mixing parameter ratio plane.

15. A program storage device readable by machine, tangibly embodying a program of instructions executable by the machine to perform method steps for denoising signal mixtures so as to extract a signal of interest, said method steps comprising:

receiving a pair of signal mixtures;

constructing a time-frequency representation of each mixture;

constructing a pair of histograms, one for signal-of-interest segments, the other for non-signal-of-interest segments;

combining said histograms to create a weighting matrix;

rescaling each time-frequency component of each mixture using said weighting matrix; and

resynthesizing the denoised signal from the reweighted time-frequency representations.

16. A system for denoising signal mixtures so as to extract a signal of interest, comprising:

means for receiving a pair of signal mixtures;

means for constructing a time-frequency representation of each mixture;

means for constructing a pair of histograms, one for signal-of-interest segments, the other for non-signal-of-interest segments;

means for combining said histograms to create a weighting matrix;

means for rescaling each time-frequency component of each mixture using said weighting matrix; and

means for resynthesizing the denoised signal from the reweighted time-frequency representations.